Pion-Kaon correlation in Au+Au collisions at $\sqrt{s_{NN}} = 130$ GeV

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Non-identical two particle correlations can be used to probe possible differences in the average emission time and position of different particle species[1]. This method relies on the fact that non-identical particles are correlated due to Coulomb and nuclear interactions. Such two-body final state interactions are different wether both particles are moving toward each other or away from each other. In this analysis, we define the correlation functions C_+ and C_- constructed from the pion-kaon pairs where the pion is faster, respectively slower, than the kaon, in the transverse plane. The ratio C_-/C_+ deviates from unity if pions are not emitted in average at the same time or position than kaons.

The pions and kaons used in this analysis are measured by the STAR Time Projection Chamber, in Au+Au collisions at $\sqrt{s_{NN}} = 130$ GeV. The upper panel of Fig. 1 shows the $\pi^- - K^+$, $\pi^+ - K^-$, $\pi^- - K^-$, and $\pi^+ - K^+$ correlation functions. The correlation functions are constructed as a functions of $2k^*$, the pair relative momentum in the rest frame of the pair. The lower panel of Fig. 1 shows the ratio of correlation functions C_-/C_+. It clearly deviates from unity which shows that pions and kaons are not emitted in average at the same time and/or position.

To interpret the data, correlation functions are calculated from the space-time and momentum distributions provided by the H2H[2] model which reproduces the measured elliptic flow and transverse mass spectra, due to the large amount of collective flow built up in the hydrodynamic expansion and hadronic cascade stages. Fig. 1 shows the comparison of the calculations with the data. The correlation functions are well reproduced by the calculations. They provided, however, limited constraints, since they combine the transverse, longitudinal and time dimensions. The ratios C_-/C_+ are in qualitative agreement with the data. The figure also shows that the model includes both a time and spatial shift since the magnitude of the deviation from unity is reduced by a factor of two if either

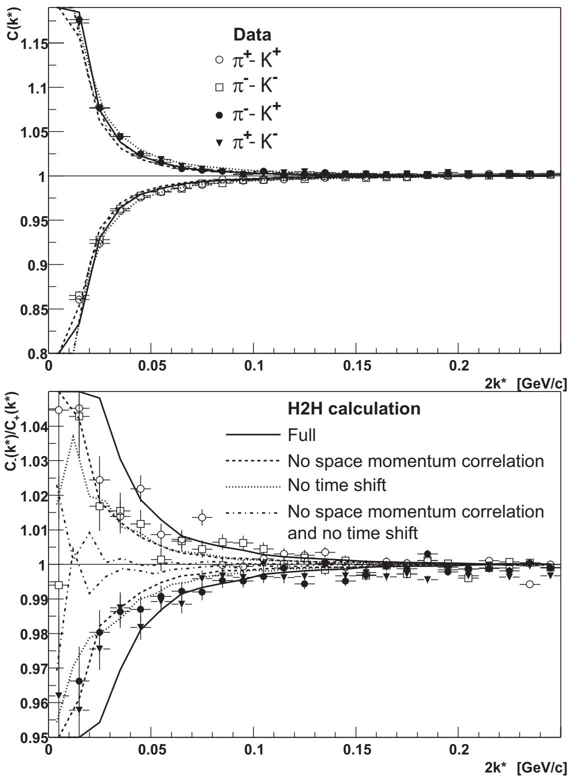

Figure 1: *Upper panel: pion-kaon correlation functions. Lower panel: ratio of correlation functions C_-/C_+.*

the time or spatial contribution is removed. Pions are emitted later than kaons because of the pion feedown of ρ and ω resonances that is not canceled out by K^* feeding down into kaons. Pions are emitted closer to the center of the source than kaons due to space-momentum correlations. Indeed, as parametrized in the blast wave framework, which also qualitatively reproduces the data[3], space-momentum correlations imply that the spatial and momentum azimuthal angles are close to each other and that the particle emission radius increases according to the transverse velocity. However, since the pion mass is small and, at low k^*, their momentum is small compare to kaons, pions are much less affected by flow than kaons. Thus, in average, the pion emission radius is smaller than the kaon one. Space-momentum correlations lead to a spatial shift of the pion and kaons sources that is directly probed by pion-kaon correlation functions.

Footnotes and References
[1] R. Lednicky, V.I. Lyuboshitz, B. Erazmus, D. Nouais, Phys. Lett. B 373 (1996) 30
[2] D. Teaney, J. Lauret, E.V. Shuryak, nucl-th/0110037

Footnotes and References
[3] F. Retière (STAR Collaboration), nucl-ex/0111013